Avoiding Common Errors

Exercises 17–19, 21–24 Some students may think that a horizontal shift in the graph of an exponential function affects the domain. Demonstrate that the domain of all exponential functions and their translations is the set of all real numbers, just as with quadratic functions. Go back to the definition of domain and point out that the value of x can be any real number in any exponential growth or decay function or any translation of these functions. You can use a graphing calculator demonstration to reinforce this idea visually.

Teaching Strategy

Exercises 31–33 Explain the concept of depreciation and how it is used in the business world. Discuss the difference between an item losing the same *dollar amount* of value each year, or "straight-line" depreciation, versus losing the same *percent* of its value each year, which is based on an exponential decay model.

27. ★ **MULTIPLE CHOICE** What is the asymptote of the graph of $y = \left(\frac{1}{2}\right)^{x-2} + 3$? **D**

Ⓐ $y = -3$ Ⓑ $y = -2$ Ⓒ $y = 2$ Ⓓ $y = 3$

C

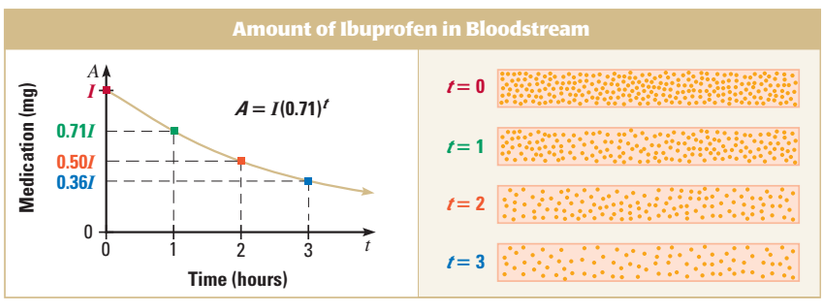
28. ★ **OPEN-ENDED MATH** Write an exponential function whose graph lies between the graphs of $y = (0.5)^x$ and $y = (0.25)^x + 3$. ***Sample answer:*** $(0.3)^x + 1$

29. **CHALLENGE** Do $f(x) = 5(4)^{-x}$ and $g(x) = 5(0.25)^x$ represent the same function? *Justify* your answer. **Yes;** $5(4)^{-x} = 5\left(\frac{1}{4}\right)^x$ **and 0.25 is the decimal equivalent to** $\frac{1}{4}$.

PROBLEM SOLVING

EXAMPLE 4 A on p. 488 for Exs. 30–31

30. **MEDICINE** When a person takes a dosage of I milligrams of ibuprofen, the amount A (in milligrams) of medication remaining in the person's bloodstream after t hours can be modeled by the equation $A = I(0.71)^t$.



Find the amount of ibuprofen remaining in a person's bloodstream for the given dosage and elapsed time since the medication was taken.

a. Dosage: 200 mg
Time: 1.5 hours

b. Dosage: 325 mg
Time: 3.5 hours

c. Dosage: 400 mg
Time: 5 hours

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30a. about 119.65 mg

30b. about 98.01 mg

30c. about 72.17 mg

31. **BIKE COSTS** You buy a new mountain bike for $200. The value of the bike decreases by 25% each year.

a. Write a model giving the mountain bike's value y (in dollars) after t years. Use the model to estimate the value of the bike after 3 years. $y = 200(0.75)^t$; **about $84.38**

b. Graph the model. **See margin.**

c. Estimate when the value of the bike will be $100. **after about 2.5 yr**

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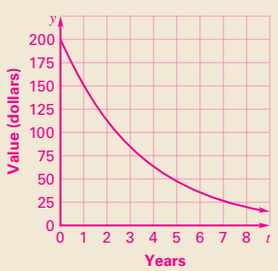
32. **DEPRECIATION** The table shows the amount d that a boat depreciates during each year t since it was new. Show that the ratio of depreciation amounts for consecutive years is constant. Then write an equation that gives d as a function of t. $\frac{1832}{1906} \approx 0.96$; $\frac{1762}{1832} \approx 0.96$; $\frac{1692}{1762} \approx 0.96$; $\frac{1627}{1692} \approx 0.96$; $d = 1985(0.96)^t$

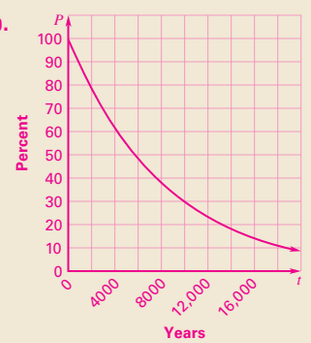
Year, t	1	2	3	4	5
Depreciation, d	$1906	$1832	$1762	$1692	$1627

31b.

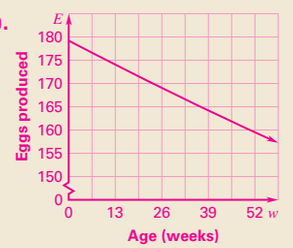


33a.

34b.



35b.



◯ = WORKED-OUT SOLUTIONS on p. WS1

★ = STANDARDIZED TEST PRACTICE

490

33. ★ **SHORT RESPONSE** The value of a car can be modeled by the equation $y = 24{,}000(0.845)^t$ where t is the number of years since the car was purchased.

a. Graph the model. Estimate when the value of the car will be \$10,000. See margin for art; after 5 yr.

b. Use the model to predict the value of the car after 50 years. Is this a reasonable value? *Explain*. \$5.29; no. *Sample answer:* A car does not normally last 50 years.

B

34. **MULTI-STEP PROBLEM** When a plant or animal dies, it stops acquiring carbon-14 from the atmosphere. Carbon-14 decays over time with a half-life of about 5730 years. The percent P of the original amount of carbon-14 that remains in a sample after t years is given by this equation:

$$P = 100\left(\frac{1}{2}\right)^{t/5730}$$

a. What percent of the original carbon-14 remains in a sample after 2500 years? 5000 years? 10,000 years? about 73.9%; about 54.6%; about 29.8%

b. Graph the model. See margin.

c. An archaeologist found a bison bone that contained about 37% of the carbon-14 present when the bison died. Use the graph to estimate the age of the bone when it was found. about 8000 yr

35. ★ **EXTENDED RESPONSE** The number E of eggs a Leghorn chicken produces per year can be modeled by the equation $E = 179.2(0.89)^{w/52}$ where w is the age (in weeks) of the chicken and $w \geq 22$.

a. **Interpret** Identify the decay factor and the percent decrease. 0.89, 11%

b. **Graph** Graph the model. See margin.

c. **Estimate** Estimate the egg production of a chicken that is 2.5 years old. about 134 eggs per yr

d. **Reasoning** *Explain* how you can rewrite the given equation so that time is measured in years rather than in weeks. Change the exponent to just w.

C

36. **CHALLENGE** You buy a new stereo for \$1300 and are able to sell it 4 years later for \$275. Assume that the resale value of the stereo decays exponentially with time. Write an equation giving the stereo's resale value V (in dollars) as a function of the time t (in years) since you bought it. $V = 1300(0.678)^t$

MIXED REVIEW

PREVIEW
Prepare for Lesson 7.3 in Exs. 37–45.

Graph the function. State the domain and range. 37–45. See margin.

37. $y = x^3 + 5$ *(p. 337)*

38. $y = x^4 - 5x^2 + 4$ *(p. 337)*

39. $y = x^4 - 9$ *(p. 337)*

40. $y = \sqrt{x} + 3$ *(p. 446)*

41. $y = \sqrt{x - 4}$ *(p. 446)*

42. $y = -\frac{1}{2}\sqrt[3]{x} + 2$ *(p. 446)*

43. $y = 3 \cdot 2^x$ *(p. 478)*

44. $y = -2\left(\frac{5}{2}\right)^x$ *(p. 478)*

45. $y = \frac{1}{3} \cdot 5^x$ *(p. 478)*

Verify that f and g are inverse functions. *(p. 438)* 46–49. See margin.

46. $f(x) = 5x - 2, g(x) = \frac{x + 2}{5}$

47. $f(x) = -3x + 10, g(x) = \frac{10 - x}{3}$

48. $f(x) = 4x^3 - 7, g(x) = \left(\frac{x + 7}{4}\right)^{1/3}$

49. $f(x) = \frac{x^5 + 7}{12}, g(x) = \sqrt[5]{12x - 7}$

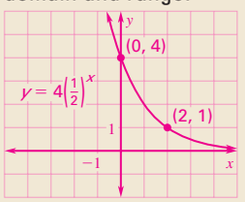
37–49. See Additional Answers beginning on p. AA1.

5 ASSESS AND RETEACH

Daily Homework Quiz

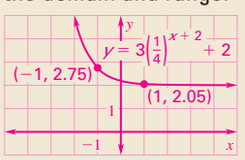
Transparency Available

1. Graph $y = 4\left(\frac{1}{2}\right)^x$. State the domain and range.



domain: all real numbers; range: $y > 0$

2. Graph $y = 3\left(\frac{1}{4}\right)^{x+2} + 2$. State the domain and range.



domain: all real numbers; range: $y > 2$

3. A new laptop computer costs \$1500. The value of the computer decreases by 22% each year.

a. Estimate the value of the computer after 2 years. about \$913

b. Estimate when the computer will be worth \$550. after about 4 yr

Online Quiz

Available at **classzone.com**

Diagnosis/Remediation

- Practice A, B, C in Chapter 7 Resource Book, pp. 19–21
- Study Guide in Chapter 7 Resource Book, pp. 22–23
- Practice Workbook, pp. 110–111
- @HomeTutor

Challenge

Additional challenge is available in the Chapter 7 Resource Book, p. 26.